NPOESS Requirements Documents

APPENDIX “A”

for

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS) SENSORS

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APPENDIX A

DEFINITION/GLOSSARY OF TERMS

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10.1 The following are general definitions used throughout the NPOESS program. Please refer to the applicable requirements document(s) on your contract for a more detailed explanation of the terms which affect your specific application.

Airglow

A natural electromagnetic radiation arising from chemical reactions of upper atmospheric constituents. Airglow occurs as emission continua, atomic lines, and molecular bands, with the brightest contributions arising from atomic oxygen and OH. Airglow extends from the ultraviolet, through visible, to the SWIR spectrum, occurs in the 70-300 km altitude range, and is both temporally and spatially variable.

Albedo (Surface)

The ratio of the solar electromagnetic power in a specified band reflected from a surface element of the earth to the total in-band power incident upon it.

Ancillary Data

Any data which is not produced by the NPOESS System, but which NPOESS EDR algorithms require to meet the EDR attributes given in the TRD Appendix D (e.g., terrain height database or conventional surface and upper air observations).

API (Antecedent Precipitation Index)

An estimate of surface moisture based on rainfall history. API includes both surface water and soil moisture. Soil moisture (columnar %) may be computed from API by dividing API by the depth of the soil (in mm), to yield the equivalent vertical mm of water per unit vertical mm depth of soil. Soil moisture (% by weight) may be computed from API by dividing API by the soil bulk density (requires knowledge of soil type).

Argos

A satellite-based location and data collection system dedicated to monitoring the environment.

Centrals

Elements of the NPOESS System which are designated data processing centers. For example, NOAA/NESDIS.

Centrals Element

The Centrals element will be that equipment and software necessary to ingest and store (temporarily) the RDRs, and process them as necessary into SDRs and EDRs. The currently defined Centrals are AFWA, NOAA/NESDIS, FNMOC, NAVOCEANO, and 55 SWXS.

Cloud

An aggregate of minute non-precipitating water and/or ice particles in the atmosphere above the earth's surface. "Cloud" is always to be interpreted to mean "detectable cloud," as defined in this glossary.

Cloud cover

The fraction of a given area that is overlaid in the local normal direction by clouds. It is the fraction of the earth's horizontal surface that is masked by the vertical projection of clouds.

Cloud type

The classification of clouds into the 18 types given in Tables 3-19 and 3-20 of the Federal Meteorological Handbook 1B.

Common Support Equipment (CSE)

Support equipment capable of common use by various systems throughout DOD, NOAA, and NASA, as applicable.

Communications Security (COMSEC)

Measures taken to provide protection for the transmission of classified and sensitive unclassified information.

Computer Security (COMPUSEC)

Measures taken to provide protection for the processing of classified and sensitive unclassified information.

Co-Registration of Spectral Bands

Co-registration of spectral bands is measured by the displacement of corresponding pixels in two different bands from their ideal relative location. Two pixels are "corresponding" if their footprints should ideally coincide or if the footprint of one should ideally lie within a specific region of the footprint of the other. If co-registration is specified by a single value, this value is the upper bound on the magnitude of the displacement of the locations of corresponding pixels in any direction.

Critical Failure

Any fault, failure or malfunction which results in the loss of the System's ability to provide any key attribute of a key EDR or other key performance parameter (e.g., data access).

Design Service Life

The design service life of the satellite is at least 15 years. This includes the time allowed for test, storage, prelaunch checkout, launch and injection, on-orbit, recovery, and contingency time. It includes the 7 year on-orbit design life and up to 3 years of intermittent testing..

Detectable Cloud

An aqueous aerosol having a vertical extinction optical depth exceeding 0.03 (*TBR*) in the visible or a contrast with the background exceeding 0.02 (*TBR*) in the visible. Contrast with the background is defined as the difference between the cloud and adjacent background radiance divided by the sum of these two radiances. "Cloud" is always to be interpreted to mean "detectable cloud."

Drop Size Distribution

The number of aerosol, cloud, or rain droplets per specified size interval per unit volume over a specified range of sizes.

Electron Density Profile

The density of free electrons as a function of altitude. It is generally derived from both ionospheric sounding data and theory.

Electronic Counter-Countermeasures (ECCM)

Measures taken to counter electronic warfare susceptibility and vulnerability of a specific system.

Environmental Data

Environmental data (also termed "mission data") refers to all data: atmospheric, oceanographic, terrestrial, space environmental, and climatic, being sensed and collected by the satellite or derived, at least in part, from these measurements.

Environmental Data Records (EDRs)

Data records that contain the environmental parameters or imagery required to be generated as user products as well as any ancillary data required to identify or interpret these parameters or images. EDRs are generally produced by applying an appropriate set of algorithms to Raw Data Records (RDRs)

Field Terminals

DoD tactical field element terminals such as the AN/SMQ-11 and TESS used by the USN; the Mark IV used by the USMC and AF; and the Mark IVB and STT used by the AF and any identified follow-on terminals.

Full Operational Capability

The System full operational capability (FOC) will be met when: a full NPOESS satellite constellation meeting all contractual system requirements is operational; sufficient C3 and mission data recovery resources are available; sufficient crews are trained; sufficient logistics resources are in place to support C3S, data recovery, and IDPS operations; and approval to operate at the secondary SOC is received.

Full Mission Capability

The full mission capability exists when: a full satellite constellation is operational (currently anticipated to be two US and one METOP); sufficient C3 and mission data recovery resources are available; sufficient crews are trained; sufficient logistics resources are in place to support C3, data recovery, and the IDP segment; and approval to operate at the secondary SOC received.

Geoid

The gravitational equipotential surface corresponding to mean sea level.

Geomagnetic Field

The magnetic field of the Earth.

Global Coverage

Global coverage denotes the observation of all points on the Earth or its atmosphere (with the exception of gaps centered over the poles consistent with the allocated swath width), at least once per given time period.

Goal

A “goal” value for a specified parameter is the minimum (maximum) of the range of preferred values for the parameter, where lower (higher) values of the parameter provide better performance or are otherwise more desirable. A design value falling between the target and goal values is desired by the government, and a value closer to the goal than the target is generally preferred, depending upon the impacts associated with approaching the goal. (See “target”.)

Haze

Fine dust, salt particles, smoke, or water particles (finer and more scattered than those of fog) dispersed though a part of the atmosphere, causing a lack of transparency of the air (which assumes a characteristic opalescent appearance that subdues all colors) and reducing the horizontal visibility of distant objects to more than one but less than two kilometers.

High Data Rate

Refers to the real time data link to field terminals which contains data at all channels (TBR) at the smallest scale horizontal spatial resolution (or cell size) required in TRD Appendix D.

Horizon

The actual lower boundary of the observed sky or upper outline of terrestrial objects including nearby natural obstructions.

Horizontal Cell Size

For a parameter which is an estimate of the uniform spatial average of an environmental parameter over a square region of the earth’s surface or within a square layer of the atmosphere, the side length of this square region or layer. (For a parameter which is an estimate of an environmental parameter at a point, the horizontal cell size is defined to be zero.) For a reported parameter not of this type but which is defined for a square region of the earth’s surface or a square layer of the atmosphere (e.g., cloud cover, ice concentration, etc.), the side length of this square region. (See the CrIS Unique SRD Para 3.2.1.1.1.1 for a CrIS-unique definition.)

Horizontal Coverage

The horizontal spatial extent of the region within which estimates of an environmental parameter are made and reported.

Horizontal Reporting Interval

The spacing between nearest neighbor points in the horizontal direction at which an environmental parameter is estimated and reported. For atmospheric profiles, the horizontal reporting interval applies to the lowest altitude samples. (See the CrIS Unique SRD Para 3.2.1.1.1.1 for a CrIS-unique definition.)

Horizontal Spatial Resolution

For a scanning imager on a space-based platform, a specified band, and a specified nadir angle, one half of the wavelength corresponding to the earth surface spatial frequency at which the end-to-end system modulation transfer function (MTF) equals 0.5 on the in-track spatial frequency axis or cross-track spatial frequency axis, whichever is greater. The in-track (cross-track) spatial frequency is the earth surface spatial frequency associated with the in-track (cross-track) direction. "End-to-end" in this definition means from photons collected by the sensor to calibrated radiances provided as part of the explicit Imagery EDR or within SDRs used to generate other EDRs. The effects of all signal and data processing functions performed in the course of generating these calibrated radiances, e.g., sample aggregation, re-sampling, image enhancement, image restoration, etc., are included in the HSR. (See definition of Modulation Transfer Function.)

Horizontal Wind Vector Accuracy

The wind speed error is $| |W_m| - |W_t| |$ where: W_m is the measured velocity and W_t is the true velocity. The wind direction error is the angular difference between the directions of W_m and W_t.

Housekeeping

Functions such as orbit and attitude maintenance, navigation, power, command, telemetry and data handling, structure, rigidity, alignment, heater power, temperature measurements, etc.

Imagery

Two-dimensional array of numbers, in digital format, each representing the brightness of a small elemental area.

Initial Operating Capability

IOC has been met when: two satellites are operational; sufficient C3 and mission data recovery resources are available to allow all mission data to be processed at all Centrals and 50 percent of field terminals; sufficient crews are trained to allow 24 hours/day, 365 days/year operations at the primary SOC, and to allow backup operations as needed; sufficient sustaining engineering resources are in place to allow for anomaly resolution, for example; sufficient logistics resources are in place to support C3, data recovery, and the IDP segment; and approval to operate at the secondary SOC is received.

Insolation

The solar radiation flux at the surface of the earth.

Ionospheric Scintillation

The random fluctuation of the amplitude and phase of a radio-frequency signal caused by passing through the ionosphere.

Key Attribute

An EDR attribute that is a key performance parameter of the system. See Key Parameter.

Key EDR

An EDR which has a key attribute. See Key Attribute.

Key Parameter/Key Performance Parameter (KPP)

A parameter so significant that failure to meet the threshold requirement(s) pertaining to its measurement is cause for the System to be reevaluated or the program to be reassessed or terminated. Key parameters include key attributes of key EDRs and the data access requirement. Key parameter requirements are to be included in the Acquisition Program Baseline. (The term "Key Performance Parameter" is used in the IORD.)

Key Sensor

A sensor which is required to meet key performance parameter requirements.

Lead

Any fracture or passageway through sea ice which is navigable by surface vessels.

Line Replaceable Unit

The smallest unit that can be removed and replaced without cutting or desoldering connections.

Local Average Revisit Time

The average time interval between consecutive measurements of a parameter at a given location on the earth's surface over a time period much greater than an orbital period. Local average revisit time so defined is a function of location on the earth's surface.

Local Refresh

The maximum time interval between consecutive measurements of a parameter at a given location on the earth's surface over a time period much greater than an orbital period. Local refresh so defined is a function of location on the earth's surface.

Local Revisit Time

The time interval between consecutive measurements of a parameter at a given location on the earth's surface. In general, successive revisit times at the same location will not be equal, and the distributions of revisit times during a given period of time at different locations will be different.

Local Time Range

For an in-situ/in-track measurement, range or ranges of ascending/descending times within which NPOESS spacecraft should be capable of measuring an EDR. Measurements outside of the specified range or ranges are not required.

Long-term Stability

The difference between the maximum and minimum short-term means of an estimated parameter over the NPOESS life cycle. This estimate may be the result of a direct measurement, an indirect measurement, or an algorithmic derivation. The short-term mean is defined as the mean of a set of estimates of the parameter satisfying the following three conditions:

(1) The physical measurements on which the estimates are based, at least in part, are performed within a specified time period. (This time limit does not apply to databases or other ancillary data sources which may be used to generate the estimate.)
(2) The set is large enough so that the sample size error (see definition) in the short-term mean is much smaller than the specified long-term stability value.
(3) The true value of the parameter is the same for all estimates in the set.

The third condition is imposed because a long-term stability requirement must be met for any true value of the parameter within the measurement range (see definition), not in an average sense over the measurement range. In practice, such as in the analysis of simulation results or measured calibration/validation data, it is understood that measurements will be binned into sets for which the true value of the parameters falls into a narrow range, preferably a range much smaller than the required measurement range. Corrections for known temporal changes in sensor performance characteristics and for differences in sensor performance characteristics from satellite to satellite are considered to be part of the parameter estimation process. Retrospective processing and re-analysis of data is allowed for the purpose of meeting a long-term stability requirement.

The long-term stability ρ is given by the following formula:

$$\rho = \max\{\mu_N(t)\}_{0 \le t \le T-T'} - \min\{\mu_N(t)\}_{0 \le t \le T-T'},$$

where: $\mu_N(t)$ is the short-term mean at time t, T is the NPOESS life cycle, T' is the maximum duration of the period during which measurements contributing to the short-term mean are performed, and the minimum and maximum are taken over the time period from t = 0, which is defined to be the beginning of the NPOESS life cycle, to t = T - T'.

The short-term mean $\mu_N(t)$ is given by the following formula:

$$\mu_N(t) = (\Sigma_{i=1,N}\ x_i(t'))/N\ , \quad 0 \le t \le T - T',$$

where: $x_i(t')$ is the value obtained in the i'th estimate of the parameter at time t', $\Sigma_{i=1,N}$ denotes summation from i = 1 to i = N, and $t \le t' \le t + T'$. The value of N is large enough so that the sample size error is much less than the required long term stability value for any time t in the range $0 \le t \le T - T'$.

If long term stability is specified as a percentage, the percentage is with respect to the mean M_N of the short-term mean $\mu_N(t)$ over the NPOESS life cycle. M_N is given by the following formula:

$$M_N = (1/(T - T')) \int \mu_N(t)\, dt$$

where the integral is over the range $0 \le t \le T - T'$. Long term stability expressed as a percentage is given by:

$$100 \times \rho/M_N$$

where ρ is defined above.

Longwave Radiation

The radiation that is emitted by the Earth or the atmosphere. It is generally in the spectral wavelength interval between 4 and 50 micrometers.

Low Data Rate

Refers to real time data link to field terminals containing fewer channels and/or coarser resolution than the high data rate real time link.

Mapping Uncertainty

The RMS error (one sigma) in the geolocation of measured or derived data samples, expressed in geodetic coordinates, based on a large number of repetitions of the measurement and/or derivation. An "error" is defined as the difference between the measured or derived value and the true value of a parameter. Mapping uncertainty is due to the combined effect of all systematic and random errors affecting geolocation.

Maximum Local Average Revisit Time

The maximum value of local average revisit time over the set of all locations within a given area of the earth's surface. Unless otherwise specified, the area is defined to be the horizontal coverage region of the measured parameter. Where constraints on the area are specified, e.g., "clear," "cloudy," etc., the area is defined to be the sub-region of the horizontal coverage region satisfying the constraint.

Maximum Local Refresh

The maximum value of local refresh over the set of all locations within a given area of the earth's surface. Unless otherwise specified, the area is defined to be the horizontal coverage region of the measured parameter. Where constraints on the area are specified, e.g., "clear," "cloudy," etc., the area is defined to be the sub-region of the horizontal coverage region satisfying the constraint.

Mean Down Time (MDT)

Mean down time (MDT) is calculated as:

$$MDT = \frac{\text{total time down from downing events}}{\text{number of downing events}}$$

Mean Time Between Critical Failure (MTBCF)

The total amount of mission time divided by the total number of critical failures during a stated series of missions. Mean time between critical failure (MTBCF) is calculated as:

$$MTBCF = \frac{\text{operating time}}{\text{number of critical failures}}$$

Mean Time Between Downing Events (MTBDE)

Mean time between downing events is calculated as:

$$MTBDE = \frac{\text{operating time}}{\text{number of downing events}}$$

Mean Time Between Failures (MTBF)

The mean number of life units during which all parts of the item perform within their specified limits, during a particular measurement interval under stated conditions.

Mean Time To Repair (MTTR)

The sum of corrective maintenance times at any specific level of repair divided by the total number of failures within an item repaired at that level during a particular interval under stated conditions.

Mean Time To Restore Functions (MTTRF)

Mean time to restore functions is calculated as:

$$\text{MTTRF} = \frac{\text{total time down from critical failures}}{\text{number of critical failures}}$$

Measurement Accuracy

The magnitude of the difference between the mean estimated value of a parameter and its true value (see definition). This estimate may be the result of a direct measurement, an indirect measurement, or an algorithmic derivation. The mean is based on a set of estimates satisfying the following two conditions:

(1) The set is large enough so that the sample size error (see definition) in the measurement accuracy is much smaller than the specified measurement accuracy value.
(2) The true value of the parameter is the same for all estimates in the set.

The second condition is imposed because a measurement accuracy requirement must be met for any true value of the parameter within the measurement range (see definition), not in an average sense over the measurement range. In practice, such as in the analysis of simulation results or measured calibration/validation data, it is understood that measurements will be binned into sets for which the true value of the parameters falls into a narrow range, preferably a range much smaller than the required measurement range.

For an ensemble of N estimates of the parameter x, the measurement accuracy β_N is given by the following formula:

$$\beta_N = |\mu_N - x_T|$$

where: μ_N is the sample mean, x_T is the true value of the parameter, and |…| denotes absolute value. The sample mean μ_N is given by the following formula:

$$\mu_N = (\Sigma_{i=1,N}\ x_i)/N$$

where: x_i is the value obtained in the i'th estimate of the parameter x and $\Sigma_{i=1,N}$ denotes summation from i = 1 to i = N.

Measurement Error

The difference between the estimated value of a parameter and its true value. This estimate may be the result of a direct measurement, an indirect measurement, or an algorithmic derivation.

The measurement error ε is given by:

$$\varepsilon = x_E - x_T$$

where: x_E is the estimate of the parameter x and x_T is its true value (see definition).

Measurement Precision

The standard deviation (one sigma) of an estimated parameter. This estimate may be the result of a direct measurement, an indirect measurement, or an algorithmic derivation. The standard deviation is based on a set of estimates satisfying the following two conditions:

(1) The set is large enough so that the sample size error (see definition) in the measurement precision is much smaller than the specified measurement precision value.
(2) The true value of the parameter is the same for all estimates in the set.

The second condition is imposed because a measurement precision requirement must be met for any true value of the parameter within the measurement range (see definition), not in an average sense over the measurement range. In practice, such as in the analysis of simulation results or measured calibration/validation data, it is understood that measurements will be binned into sets for which the true value of the parameters falls into a narrow range, preferably a range much smaller than the required measurement range.

For an ensemble of N estimates of the parameter x, the measurement precision σ_N is given by the following formula:

$$\sigma_N = [\Sigma_{i=1,N} (x_i - \mu_N)^2/(N - 1)]^{1/2}$$

where: μ_N is the sample mean (defined in the definition of measurement accuracy), x_i is the value obtained in the i'th estimate of the parameter x, and $\Sigma_{i=1,N}$ denotes summation from i = 1 to i = N.

Measurement Range

Range of values over which a parameter is to be estimated while meeting all other measurement requirements. This estimate may be the result of a direct measurement, an indirect measurement, or an algorithmic derivation.

Measurement Sample Size Error

The standard deviation of the finite sample mean (square root of the variance) over the infinite universal ensemble of possible measurements. The sample size error must be much smaller than the required value of accuracy for any simulation which purports to verify that the accuracy requirement is met.

Measurement Uncertainty

The root-mean-square (RMS) of the measurement errors (see definition) for an estimated parameter. This estimate may be the result of a direct measurement, an indirect measurement, or an algorithmic derivation. The measurement uncertainty is based on a set of estimates satisfying the following two conditions:

(1) The set is large enough so that the sample size error (see definition) in the measurement uncertainty is much smaller than the specified measurement uncertainty value.
(2) The true value of the parameter is the same for all estimates in the set.

The second condition is imposed because a measurement uncertainty requirement must be met for any true value of the parameter within the measurement range (see definition), not in an average sense over the measurement range. In practice, such as in the analysis of simulation results or measured calibration/validation data, it is understood that measurements will be binned into sets for which the true value of the parameters falls into a narrow range, preferably a range much smaller than the required measurement range.

As defined herein, measurement uncertainty is due to the combined effects of all systematic and random errors. Also, as a consequence of its definition, measurement uncertainty converges to the square root of the sum of the squares (RSS) of the measurement accuracy and precision in the limit of infinitely large sets of measurements.

For an ensemble of N estimates of a parameter x, the measurement uncertainty ξ_N is given by the following formula:

$$\xi_N = [\Sigma_{i=1,N} (x_i - x_T)^2/N]^{1/2}$$

where: x_i is the value obtained in the i'th estimate of the parameter, x_T is the true value of the parameter, and $\Sigma_{i=1,N}$ denotes summation from i = 1 to i = N.

Mesh

A rectilinear (square) grid of lines which is superimposed upon a standard map projection. Current practice is to use a polar stereographic map projection for which each hemisphere is overlaid with a 512 x 512 square grid (called "eighth-mesh"), which is true at 60 degrees latitude, i.e., the quoted geographical grid size of the mesh (25 nmi) is true at 60 degrees latitude. A future upgrade would be the implementation of a sixteenth-mesh ("20 km") grid. ("Mesh" defined fields are also displayable as Mercator projection products.)

Meteorological Range (Rm)

An empirically consistent measure of the visual range of a target. It is defined as the distance at which optical intensity is diminished by 17 dB (or the transmittance is 0.02). Meteorological Range Ê**(Rm)** =Ê3.912/a_O, where a_O is the extinction coefficient. The extinction coefficient is defined by:

$$I(x) = I(0)\, e^{-x/a_O},$$

where: I(x) is the optical intensity at distance x.

Mid-latitudes

The set of all locations on the earth's surface between 20 and 50 degrees north latitude and between 20 and 50 degrees south latitude.

Mission Data

The combination of data provided by any of the mission sensors (i.e., environmental data) plus satellite orbit, attitude, and time tags. It does not include other sensors (i.e., S&R, SDC) or telemetry.

Mission Sensors

Any sensor on the spacecraft directly used to satisfy any of the EDR requirements of TRD Appendix D.

Mixing Ratio

In a sample of moist air, the mixing ratio is the ratio of the mass of water vapor to the mass of dry air. It is expressed in parts per thousand, usually grams of water vapor per kilogram of dry air.

Modulation Transfer Function (MTF)

The magnitude of the Fourier transform of the end-to-end system point spread function (PSF). The MTF is a function of two spatial frequencies associated with two orthogonal spatial directions, and is equal to one at the origin by virtue of the normalization condition on the PSF.

Nephanalysis

Analysis of cloud cover in terms of type and amount.

Not-to-Exceed

A "not-to-exceed" value for a specified parameter is the maximum acceptable value of the parameter

Objective

A requirement which is significantly more difficult to meet than the threshold requirement but which, if met, would greatly enhance the utility of the data to the users.

On-Orbit Design Life

The seven year period during which the satellite must meet all operational requirements.

Operational Availability

Operational Availability (A_o) is defined as the probability that a system is operable and ready to perform its mission at any given time. A_o is a function of mean time between critical failure (MTBCF) and mean time to restore functions (MTTRF) and shall be calculated as:

$$\mathrm{Ao} = \frac{\mathrm{MTBCF}}{\mathrm{MTBCF} + \mathrm{MTTRF}}$$

Operational Service Life

The period of time that the NPOESS system has to be fully operational after IOC.

Operations Security (OPSEC)

Actions taken or plans developed to protect information, classified or unclassified, which could reveal system plans, procedures, or missions.

Particle Size Parameter

The Angstrom wavelength exponent, alpha, defined as: $a = - \Delta \ln(\tau) / \Delta \ln(\lambda)$ where: tau is optical thickness, lambda is wavelength, ln denotes natural logarithm, and Δ denotes the difference between optical thickness measurements at two different wavelengths.

Payload

Used to refer to the combination of the mission sensors and the SDC and S&R sensors carried by the spacecraft. The term may also be used to refer to the satellite when it is still mated to the launch vehicle.

Pixel

Contraction of “picture element”. In general, a pixel is defined as the smallest unit of information in a grid cell map or image. As applied to VIIRS, a pixel is defined as an individual sample of measured scene data at the finest resolution of the instrument in the mode in which it is operating. A pixel may be generated from one or more detector samples by aggregation, re-sampling, and/or any other data processing operations consistent with meeting the explicit and derived requirements for pixel radiometric, spatial, and temporal response characteristics. However, re-sampling is allowed only if required to implement aggregation of pixels from multiple detector samples (TBR). Depending on the degree of processing applied to the raw detector samples, a pixel may be dimensionless, e.g., a “digital number”, or may have units of radiance or reflectance. The spatial extent on the ground of a pixel (or pixel footprint) is determined by the two-dimensional system point spread function (or point source response function) associated with the pixel. In particular, the pixel width in the in-track (cross-track) direction is given by the horizontal spatial resolution (HSR) in the in-track (cross-track) directions. (See “Horizontal Spatial Resolution” and “Pixel Width”.) The pixel location (or pixel footprint location) on the ground is the ground location at which the point spread function associated with the pixel has a maximum. (See “Pixel Location”.)

Pixel Footprint

The region on the ground associated with, or predominantly contributing to, the pixel information. The location and spatial extent of the pixel footprint are determined by the system point spread function associated with the pixel. (See “Pixel Width” and “Pixel Location”.)

Pixel Location (or Pixel Footprint Location)

The pixel location (or pixel footprint location) is defined as the point on the ground at which the system point spread function associated with the pixel has a maximum. If the point spread function achieves its maximum over a finite region rather than at a point, then the pixel location is the centroid of this region.

Pixel Width (or Pixel Footprint Width)

The pixel width in the in-track (cross-track) direction is defined as the horizontal spatial resolution (HSR) in the in-track (cross-track) direction. Other terms having the same meaning as “pixel width” are “pixel size”, “pixel extent”, “pixel dimension”, and “pixel HSR”.

Point Spread Function (PSF)

See System Point Spread Function.

Polarization Sensitivity (or Polarization Factor)

The polarization sensitivity (or polarization factor) (PF) is defined as:

$$PF = (I_{max} - I_{min})/(I_{max} + I_{min})$$

where
I_{max} = maximum measured radiance for linearly polarized source radiance for which the plane of polarization contains the line of sight and has any orientation about the line of sight.
I_{min} = minimum measured radiance for linearly polarized source radiance for which the plane of polarization contains the line of sight and has any orientation about the line of sight.

Precipitable Water

The total amount of water and ice contained in a vertical column of the atmosphere.

Primary EDR

EDR for which a sensor contractor has been assigned primary sensor and algorithm development responsibility, either under all conditions or prescribed conditions (e.g., clear versus cloudy conditions). The algorithm may or may not require the use of additional data from other sensors for which the EDR is not primary.

Probability of Correct Typing

Probability that a horizontal cell reported as being of type x is in fact of type x, where x is any allowed type.

Radiance Reference Levels

In the reference 0.4 - 1.0 μm bandpass, an overhead sun at nadir produces a radiance of 2.65×10^{-2} W/cm^2-sr at the location of the satellite for an earth surface albedo of unity; the radiance is 5.7×10^{-4} W/cm^2-sr when the terminator is at nadir.

Raw Data Records (RDRs)

Full resolution, unprocessed digital sensor data, time-referenced and earth (GEO) located (or orbit-located for in-situ measurements), with radiometric and geometric calibration coefficients appended, but not applied, to the data. Aggregates (sums or weighted averages) of detector samples are considered to be full resolution data if the aggregation is normally performed to meet resolution and other requirements. Sensor data should be unprocessed with the following exceptions: time delay and integration (TDI), detector array non-uniformity correction (i.e., offset and responsivity equalization), and lossless data compression are allowed. All calibration data will be retained and communicated to the ground without lossy compression. Note that for the real time transmission of raw data to field terminals, lossy compression is allowed. Additionally, reduced resolution is allowed in transmission of raw data to low data rate field terminals.

Reflectance (Band Integrated, Top of the Atmosphere (TOA))

The band-integrated TOA reflectance ($\rho(\theta,\varphi;\theta_s,\varphi_s)$) is defined as follows:

$$\rho(\theta,\varphi;\theta_s,\varphi_s) = \frac{\pi \int_0^\infty L(\theta,\varphi;\lambda)\, R(\lambda)\, d\lambda}{\int_0^\infty E(\lambda)\, R(\lambda)\, d\lambda \cos(\theta_s)}$$

where
θ = zenith angle of the observing sensor,
φ = azimuth of the observing sensor,
θ_s = zenith angle of the illuminating source (e.g., the sun or moon).
φ_s = azimuth of the illuminating source,
λ = wavelength,

$L(\theta,\varphi;\theta_s,\varphi_s)$ = TOA spectral radiance in the direction of the observing sensor,
$E(\lambda)$ = irradiance due to the illuminating source orthogonal to the line of sight to the illuminating source, $R(\lambda)$ = relative spectral response function of the sensor in the band of interest.
Unless otherwise indicated, the unmodified term "reflectance" as used in the SRD refers to the band-integrated, TOA reflectance defined above.

Reporting Frequency

The mean time between successive reports of an EDR. Where reporting frequency is specified "per orbit" or "per satellite," it is the mean time between successive reports of an EDR based on measurements from a single satellite. (Reporting frequency applies to EDR parameters that are not associated with localized portions of the earth's surface or a column of the atmosphere, e.g., in-situ measurements, solar irradiance measurements, etc. The times between consecutive observations of a parameter associated with a localized portion of the earth's surface or a column of the atmosphere are described by a constellation dependent distribution which varies from place to place. The attributes "maximum local average revisit time" and "maximum local refresh," which are defined in terms of these earth location dependent distributions, are used for these EDR parameters.)

Root-Mean-Square Error (RMSE)

The root-mean-square error (RMSE) is defined as the square root of the sum of the squares of the measurement errors associated with a set of measurements or estimates. (See "measurement error".)

Sample Size Error

The standard deviation of a function of a finite set of estimates of a parameter. These estimates may be the result of direct measurement, indirect measurement, or algorithmic derivation. The standard deviation is based on the ensemble of all possible finite sets of estimates. Sample size error is a measure of the width of the probability distribution of a function of a finite set of estimates.

If $\theta_N(x_1, x_2, \ldots, x_N)$ is a parameter depending on N estimates of a parameter x, i.e., $x_1, x_2, \ldots, x_N$, the sample size error is given by the following formula:

$$S_N = \langle (\theta_N(x_1, x_2, \ldots, x_N) - \langle \theta_N(x_1, x_2, \ldots, x_N) \rangle)^2 \rangle^{1/2}$$

where: $\langle \ldots \rangle$ denotes the expectation value over the ensemble of all possible sets of N estimates of x.

The measurement accuracy, precision, uncertainty, and short-term mean (see definition of long term stability) are all examples of functions of a finite set of estimates of a parameter.

Satellite

The spacecraft and its sensor payload.

Sea Ice Properties

Ice properties of the polar regions, including concentration, thickness, age, lead concentration, polynya concentration, iceberg distribution, etc.

Sea Surface Height/Topography

The height of the sea surface relative to the center of mass of the earth.

Secondary EDR

EDR for which a sensor may provide data as a secondary input to an EDR algorithm assigned as a primary EDR to another sensor contractor, either under all conditions or prescribed conditions (e.g., clear versus cloudy conditions).

Secondary Mission Capability

The secondary mission capability is provided when mission sensors other than the Imager and Profiler Suites are capable of delivering their RDRs to the C3S and IDPS, as required.

Sensor

The mission-peculiar equipment or instrument to be manifested on a given space mission.

Sensor Data Records (SDRs)

Full resolution sensor data that are time referenced, earth (GEO) located (or orbit-located for in-situ measurements), and calibrated by applying the ancillary information including radiometric and geometric calibration coefficients and georeferencing parameters such as platform ephemeris. These data are processed to sensor units (e.g., radar backscatter cross section, brightness temperature, radiance, etc.). Calibration, ephemeris, and any other ancillary data necessary to convert the sensor units back to sensor raw data (counts) are included.

Sensor Suite

One or more sensors needed to satisfy the EDR requirements allocated to a given Sensor Requirements Document (SRD). It does not include sensors from other SRD suites which provide secondary data contributions to those EDRs.

Short-term Stability *(TBS)*

Short-wave Radiation

The solar radiation that is reflected back by the Earth and the atmosphere. It is generally in the spectral wavelength interval between 0.3 and 4 micrometers.

Significant Wave Height

The height of a theoretical wave whose height and period are equal to the average height and period of the largest one-third of the actual waves that pass a fixed point in some time period.

Soil Moisture

Moisture in the soil within the zone of aeration in cm/m (cm of water per meter of soil depth), including water vapor present in soil pores.

Spacecraft

The components and subsystems which support the sensor(s) and provide housekeeping functions such as orbit and attitude maintenance, navigation, power, command, telemetry and data handling, structure, rigidity, alignment, heater power, temperature measurements, etc.

Space Segment

The satellites (i.e., the spacecraft and their sensors) and their support equipment.

Spectral Index

Slope of the irregularity power spectrum of the electron energy density between two inverse scale lengths.

System Point Spread Function (PSF)

The end-to-end system response due to a point source at infinity in a given bandpass. In the SRD, the PSF is considered to be a function of distance along the ground in two orthogonal directions. (A point source on the ground is considered to be "at infinity.") The PSF is normalized so that the two dimensional integral over the two orthogonal distance variables is equal to one. For a linear system, the system PSF can be expressed as a multiple convolution of the PSFs associated with all system components that contribute to the conversion of input radiance to the system output, e.g., the optics, detectors, signal and data processing.

Target

A "target" value for a specified parameter is the maximum (minimum) of the range of preferred values for the parameter, where lower (higher) values of the parameter provide better performance or are otherwise more desirable. A design value falling between the target and goal values is desired by the government, and a value closer to the goal than the target is generally preferred, depending upon the impacts associated with approaching the goal. (See "goal".)

Telemetry

Health and status data of the satellite, including command authentication.

Temperature Data Records (TDRs)

See Sensor Data Records (SDRs)

TEMPEST

Short name referring to the investigation, study, and control of compromising emanations from telecommunications and automated information systems equipment.

Threshold

The less stringent of the two requirements imposed on each measured or derived parameter. The more stringent requirement is the "objective." (See definition above.) Failure to meet a threshold requirement for a non-key performance parameter renders the utility of the System questionable, at least to some segment of the user community. Failure to meet a threshold requirement for a

key performance parameter is much more serious and places the entire program at risk. (See definition of "key performance parameter" above.)

Tides

The periodic component of the sea surface topography induced by the gravitational interaction among the earth, moon, and sun.

Timeliness

Elapsed time between the initiation of the measurement(s) necessary to generate an estimate of an environmental data characteristic and delivery of the EDR containing the estimate to the user site.

Total Water Content

Total water content has two components: 1) Total columnar cloud liquid water content (CLWC), and 2) Total columnar integrated water vapor (TIWV).

Tropopause

The upper boundary of the troposphere, usually characterized by an abrupt change in lapse rate from positive (decreasing temperature with height) to neutral or negative (temperature constant or increasing with height).

True Value

True value is defined in terms of *(TBR)* ground truth generally accepted in the user community. When the output of the sensor is folded into atmospheric, radiative transfer, and other models to produce EDRs, the measurement uncertainty of the EDR need not be traceable to an absolute reference standard, e.g., those maintained by the National Institute of Standards and Technology. The proof of meeting the measurement accuracy, precision, uncertainty, and long-term stability requirements has to be accomplished by analysis, laboratory measurements, simulations, and comparisons to ground based observations. The proof should include both sensor characteristics and the processing algorithms.

Unique Support Equipment

Support equipment especially designed for use with a specific system and usable only on that system.

Users

The people, such as weather forecasters, who employ the obtained environmental data.

Vegetation Index

The identification of the predominant vegetation and/or soil type in a given area (see TRD Appendix D for details).

Vertical Cell Size

For a parameter which is an estimate of the uniform spatial average of an environmental parameter within a square layer of the atmosphere, the vertical thickness of this layer. (For a

parameter which is an estimate of an environmental parameter at a point, the vertical cell size is defined to be zero.) (See the CrIS Unique SRD Para 3.2.1.1.1.1 for a CrIS-unique definition.)

Vertical Coverage

The vertical spatial extent of the region within which estimates of an environmental parameter are made and reported.

Vertical Reporting Interval

The spacing between nearest neighbor points along a local vertical at which an environmental parameter is estimated and reported. (This term is referred to as vertical sampling interval in the IORD; the terminology has been changed to avoid misinterpretation as an sensor measurement sampling interval.) (See the CrIS Unique SRD Para 3.2.1.1.1.1 for a CrIS-unique definition.)

Visible Radiation

The radiation that the human eye senses as part of the process of "seeing." It is generally in the spectral wavelength interval between 0.4 and 0.7 micrometers. The blue end is near 0.4 micrometers and the red end is near 0.7 micrometers.

Wavelength Categories -- Visible/Infrared

	Visible	0.4 - 0.7 µm
NIR	Near Infrared	0.7 - 1.5 µm
SWIR	Short-wave Infrared	1.5 - 3 µm
MWIR	Medium Wave Infrared	3 - 5 µm
LWIR	Long Wave Infrared	5 - 50 µm